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THE NEW YORK STATE BARGE CANAL

By WILFRED H. SCHOFF
Secretary, The Commercial Museum, Philadelphia

Popular interest in the completion and opening of the Panama Canal, upon which the Federal Government has incurred an expense approximating $400,000,000, has naturally tended somewhat to obscure another great American waterway now almost completed at a cost to a single state which will approximate $140,000,000. This waterway is, of course, the New York State Barge Canal, being a reconstruction on modern plans of the old Erie Canal, originally built by the State of New York and opened to traffic in 1825. Great as the national achievements have been on the Isthmus of Panama, and world-wide in its commercial importance as that waterway will be, it is not stretching the truth to say that in some of its commercial aspects the New York Barge Canal will be of even greater importance, and that its reconstruction will have a far reaching effect on freight rates and freight carriage that will be felt in normal times internationally, as well as locally. Indeed, in the construction of the Barge Canal the state engineers of New York have had to meet and overcome more varied difficulties than the army engineers in the Canal Zone, and while their work has to its credit no Gatun dam, no Culebra cut and no concrete structures equaling those of the Panama Canal in size, the New York work shows achievements second only in size to those at Panama, and in a far

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[1] This part of Mr. Schoff's paper is largely given to the development of the Erie Canal, to the causes that impelled its reconstruction and to the vast work of planning and providing for the building of the New York State Barge Canal. The remainder of the paper will describe the building of this great public work, its economic importance and its relation to other large systems of transportation.

greater variety, including problems of waterway construction never before solved. When it is realized that the excavation on the Barge Canal will exceed 115,000,000 cubic yards as compared with approximately 200,000,000 at Panama; that the concrete work on the New York Canal will approach 3,000,000 cubic yards, as compared with 5,000,000 at Panama; that the length of the New York waterway is 540 miles, as compared with 50 at Panama; with 39

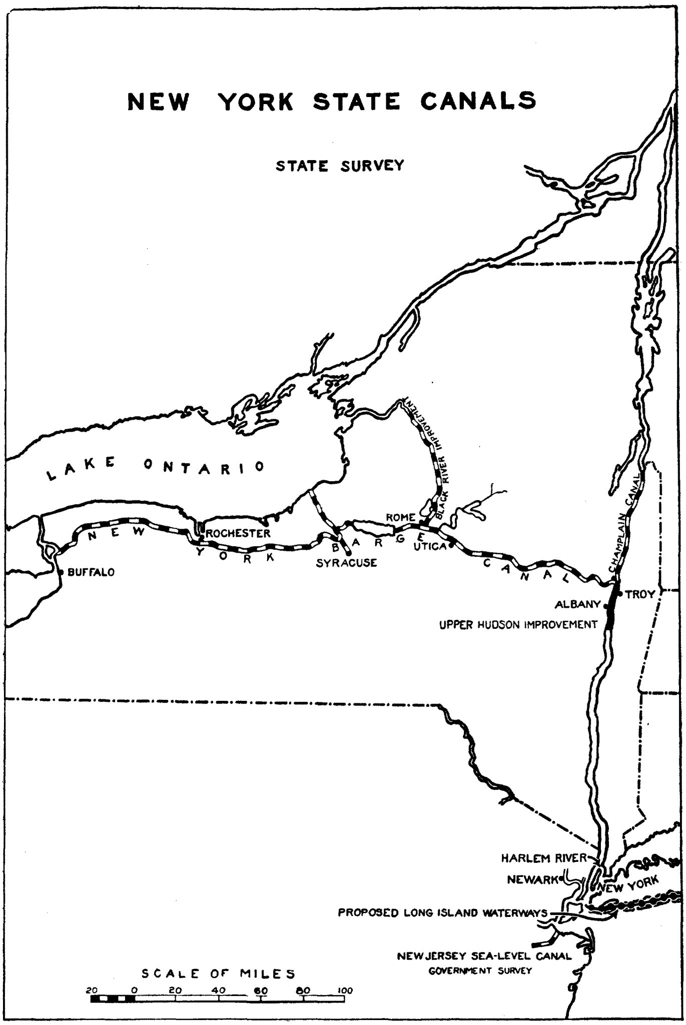

Fig. 1—Sketch Map of New York Barge Canal and connections.

dams as against 4 on the Isthmus; 57 locks as against 6; with an infinity of aqueducts, bridges, by-passes, spillways and other hydraulic structures not thought of at Panama; with the watershed of a large part of the Adirondack Mountains impounded for canal service, comparing very respectably in area, if not in total rainfall, with the Panama Canal watershed—it may be seen that the engineers and the citizens generally of New York State have a reasonable basis for pride and interest in the great work which they have undertaken. Subtracting tropical rainfall, sanitation and the peculiar instability of rock strata on the Isthmus, the problems to be surmounted there were largely of rapid and economical excavation and handling of the spoil. In New York State, on the other hand, there were rivers and lakes to be canalized; water-supply to be provided in an area of moderate rainfall; spring freshets to be cared for without damage to adjacent property; excavation to be undertaken through rock of many grades of hardness, from the loose, porous shale of western New York to the hard, flinty strata of the upper Mohawk; and the engineers were restricted in their work by the State law which required navigation on the old Erie Canal to be kept open throughout the period of reconstruction.

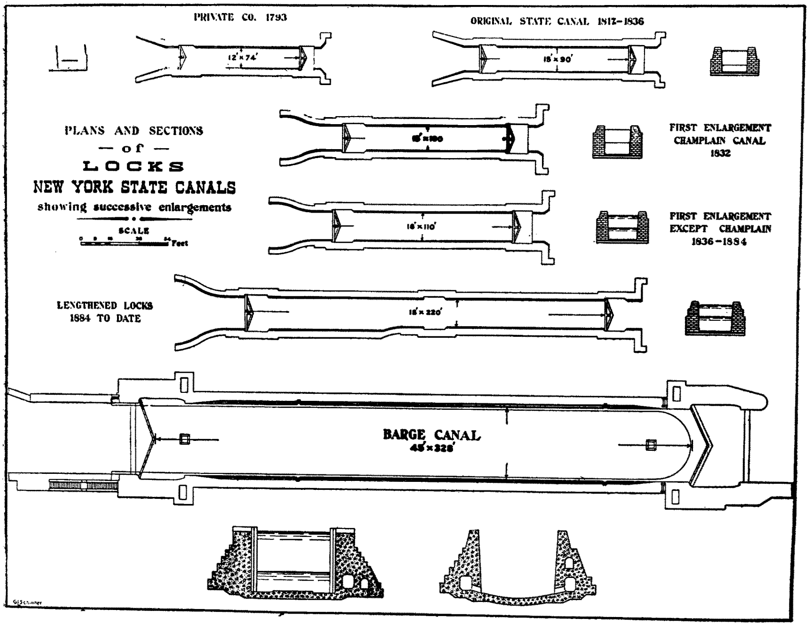

FIG. 2.

There was also in New York no possibility of organizing a great working force under military control, and therefore under conditions of the highest efficiency, the state engineer being required to parcel the work out in sectional contracts, the conditions of which required completion of some before commencing others, and the whole work being conducted under annual appropriations, great in the aggregate, but still less in amount than those available at Panama. Under these circumstances it is not at all surprising that the official opening of the New York Barge Canal may be delayed two or three years beyond the opening of the Panama Canal. But it is by no means certain that the New York work, when opened, may not be in a condition of greater stability throughout the line than that at Panama, where the dredges may be eating away at the Culebra slides for years to come. And it is certain that the New York Barge Canal when open will take rank at once among the four greatest artificial waterways in the world—the St. Mary's Falls Canal, leading in tonnage the Suez and Panama Canals, following in the order named, while the New York Barge Canal may even exceed the tonnage at Panama.

Economic Causes of the Reconstruction

The valleys of the Hudson and Mohawk Rivers formed the earliest trade route by which communication was established between the settlements on the Atlantic seaboard and the Great Lakes and the interior. The Appalachian Mountain chain, which runs parallel with the coast line from north to south, is broken at the head of the Hudson River, so that the western passage required no tedious and expensive mountain climb at that point, and the valley of the Mohawk, flowing eastward into the Hudson, formed the natural westward trade route.

As early as 1768 improvement of the Mohawk River at the Falls of Canajoharie was recommended by the Colonial Governor, Sir Henry Moore. A survey for a canal around Niagara Falls, to be utilized in connection with a system of canals and slackwater navigation by way of the Oswego and Mohawk Rivers, was made in 1784, this being substantially the same route recommended by the Federal Deep Waterway Board in 1900. The first canal law in New York was passed in 1791 authorizing the improvement of the Mohawk River to the Hudson, and in 1792 a law was passed incorporating two companies—the Western to provide transportation from the Hudson to Lake Ontario, and the Northern from the

Hudson to Lake Champlain, stock in both companies being subscribed for by the State. In the spring of 1796 the Western canals were opened from Schenectady to Seneca Falls for boats of sixteen tons capacity, and freight charges were reduced to $32 per ton for the down trip and $16 per ton for the up trip, as compared with $75 to $100 per ton, the rates previously in force. The Western Company expended about $400,000 up to 1813. The total length of its artificial channel was about fifteen miles. The locks were 12 feet x 74 feet, built of wood and afterwards changed to brick.

The Northern Transportation Company expended about $100,000 on the route from the Hudson to Lake Champlain, which was a total loss. In 1798 a law was passed for a canal around Niagara Falls, but nothing was ever done on that project.

The first suggestion of an Erie Canal as a link in a comprehensive plan of internal transportation was made by George Washington in 1784, without result. An Erie Canal undertaken by the State of New York was again suggested by Gouverneur Morris in 1803, still in advance of public opinion, but in 1808 the State Legislature authorized a survey of the route, anticipating that the Federal Government would aid in constructing the canal. This act contemplated a waterway from the Hudson to Lake Ontario, and a canal around Niagara Falls to Lake Erie. Appeals were made to Congress and to the State for aid, but without result, and in 1812 the State surveys were completed for a continuous waterway between the Hudson River and Lake Erie, substantially along the route subsequently authorized by law. The project for a canal to Lake Ontario for vessels of fifty to sixty tons capacity was rejected because of insufficient water supply at the summit level, and because freight for export once having reached Lake Ontario could be delivered at Montreal in any case at a lower cost than at New York City. At that time the greater part of the commerce at New York was from the central and western part of the State, then only recently opened for settlement after acquisition of extensive areas from the Indians; and it was considered more important to tap these central settlements than to connect with Lake Ontario. In 1812 the Legislature appropriated $5,000,000 for canal construction, but war broke out with Great Britain, and the act was promptly repealed. Construction was authorized in 1817, contracts executed in 1821, and the completed canal was opened to traffic in October, 1825.

The original canal was designed for barges of thirty tons capacity to carry 1,000 bushels of wheat, and the locks were 15 x 90 feet, the dimensions being 40 feet surface width, 4 feet depth and 26 feet bottom width. These dimensions were soon outgrown as the great interior was opened for settlement. In 1835 a general project of enlargement was approved, which was not fully completed until 1862. Under this plan the dimensions were increased to 70 feet surface width, 7 feet deep and 52 feet bottom width, and the locks were made 18 x 110 feet for barges of 100 tons capacity carrying 3,333 bushels of wheat. In 1884 the capacity of the canal was again increased, this time not by widening its sections, but by doubling the length of the locks, the dimensions of 18 x 220 feet enabling the passage of barges of 240 tons capacity carrying 8,000 bushels of wheat.

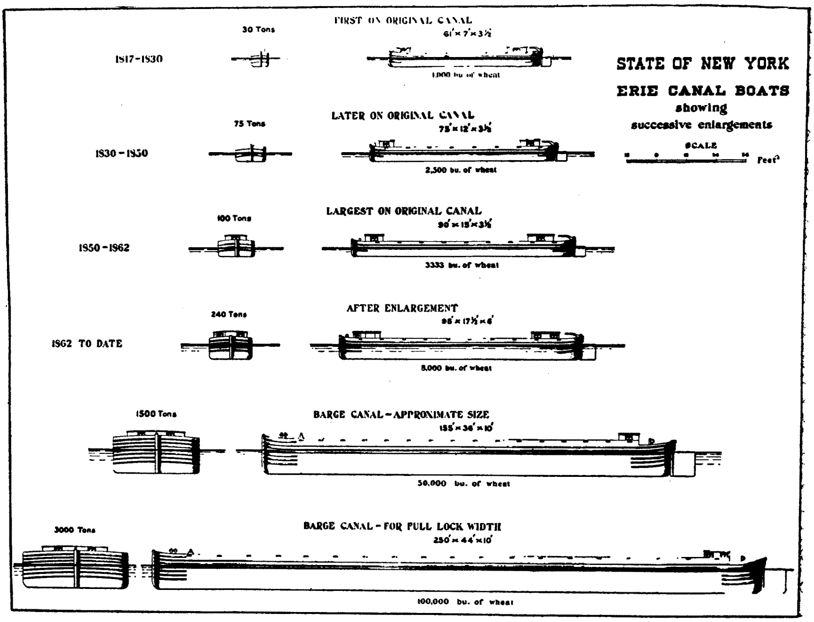

FIG. 3.

The record of the Erie Canal up to this time was one of continual usefulness and profit to the State which had constructed it. The original cost of the main line, 363 miles, was $7,143,790, and of the enlargement completed in 1862, $31,834,041. The total cost of the enterprise, including land damages and interest on loans, was $52,491,916, and of repairs 1827 to 1862, $10,995,333. These large sums were more than repaid by collection of tolls. The consolidated financial report of the Canal Department to the end of 1882 showed the following remarkable figures:

Revenues.	Cost of Collection, Supt. and Repairs	Profits from Operation	Cost of Constr. and Improv.	Net Profit
$121,461,871	$29,270,301	$92,191,570	$49,591,853	$42,599,718

At that time it was realized that the State of New York had derived a sufficient profit from its undertaking and a constitutional provision was adopted for abolition of canal tolls. For a few years business on the Erie Canal rapidly increased, but then came the period of great improvement of the railroad systems of the country, the installation of heavier rails, more powerful locomotives and larger freight cars, which made it difficult for the small old-fashioned canal barge to compete. For about fifteen years traffic on the Erie Canal steadily declined and it became a serious question whether the whole system should be abandoned, or whether the State should undertake another reconstruction on modern lines, which necessarily involved a very much greater expense than any of the earlier canal work.

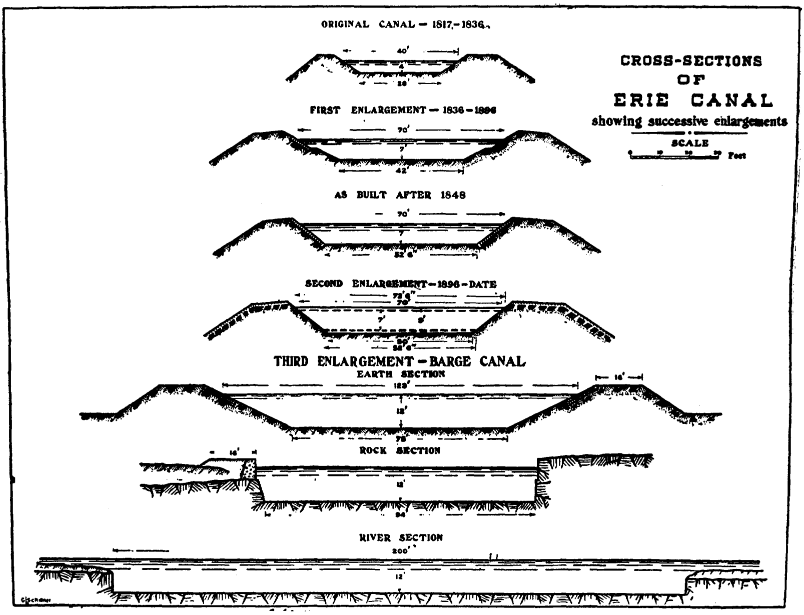
ORIGINAL CANAL – 1817–1836
40'
4
28'
CROSS-SECTIONS OF ERIE CANAL
showing successive enlargements
SCALE
0 10 20 30 Feet
FIRST ENLARGEMENT – 1836 – 1896
70'
7
42'
AS BUILT AFTER 1848
70'
7
52'6"
SECOND ENLARGEMENT – 1896 – DATE
72'6"
70'
7' 9'
50'
52'6"
THIRD ENLARGEMENT – BARGE CANAL
EARTH SECTION
123'
16'
12'
75'
ROCK SECTION
16'
12'
94
RIVER SECTION
200'
12'
G.Schenk

FIG. 4.

A United States Board of Engineers on Deep Waterways was appointed by President McKinley under an Act of Congress approved in 1897 to make surveys and examinations of deep waterways and the routes thereof between the Great Lakes and the Atlantic tide waters.

This Board made a thorough study of several routes to connect the Great Lakes with Atlantic tide waters.[2] Their report submitted to Congress in 1900, contained recommendations for a ship canal through American territory between Lake Erie and Lake Ontario, this paralleling the Canadian Welland Canal in the same way that the American and Canadian Canals parallel each other at the "Soo." Two routes were considered between Lake Ontario and the Atlantic, one running from the St. Lawrence River to Lake Champlain, and thence to the Hudson; the other running from Oswego to Oneida Lake, and thence down the Mohawk valley to the Hudson. Of these routes, the latter, Oswego-Oneida-Mohawk, was evidently the more feasible. The purpose of the army engineers was to provide a waterway of adequate size for ocean-going vessels, and of uniform descent from Lake Erie, 573 feet above sea level, to tide water. The cost was not exhaustively figured, but it was apparent that it would reach, if not exceed, $500,000,000, and the Federal Government decided that the cost of an interstate waterway was greater than it cared to undertake, and that any reconstruction of the Erie Canal should be left, like the original waterway, to the State of New York.

In New York State there had been for years an agitation on the one side for improvement of the Erie Canal, and on the other for its abandonment. Each side rested upon engineering opinion of high character. Under these circumstances, Theodore Roosevelt, then Governor of New York, appointed a Committee on Canals, headed by Gen. Francis V. Greene, who were requested to co-operate with the State Engineer and the State Superintendent of Public Works toward finding a solution of this great question. This committee reported three main conclusions: first, that the canals connecting the Hudson River with Lake Erie, Ontario and Champlain should not be abandoned, but should be maintained and enlarged; second, that the project of a ship canal to enable vessels to pass from the upper lakes to New York City or beyond without breaking bulk would be a proper subject for consideration by the Federal Government, but not by the State of New York; third, that the project of 1895 for enlargement of the Oswego and Champlain Canals should be completed.

The committee carefully considered the question of a ship canal connecting the Great Lakes with the ocean, for which at that time there was considerable popular agitation, and reported it not feasible, owing to the difficulty of constructing vessels so as to be economical and commercially successful over such a route. The ocean steamer, according to the committee's report, being built to withstand the fierce storms of the Atlantic, cost to construct about $71 per net ton of carrying capacity. The vessel to navigate the Lakes, less substantially built, designed for Lake harbors of smaller depth, and to withstand less frequent and less dangerous storms, cost about $36 per net ton of carrying capacity. The cost of the canal fleet, on the other hand, consisting of tow boat and barges, was less than $7.50 per ton; allowing for increased cost of labor and materials, the construction cost at the present time would be similarly disproportionate. The committee considered it impossible to combine the three types of vessels, having a difference in first cost as great as between $71, $36 and $7.50 per ton of carrying capacity, into one vessel which would be as economical for the through trip as to use the three existing types with two changes of cargo, one at Buffalo and one at New York. Owing to the greatly reduced speed which would be necessary over any artificial waterway, the cost of operation of the ocean-going steamer would be so largely increased as to raise necessary freight charges above barge freight plus transfers.

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[2] *House Doc. 149, 56th Congress, 2nd Session.*

This report of the committee headed by Gen. Greene was favorably received by the Legislature, but no definite action was taken for commencement of the work until the session of 1903. At that time, with the strong endorsement of Governor Odell, a bill providing for the issuance of $82,000,000 in bonds to complete a 12-foot canal for 1,000-ton barges was introduced, and upon a further report from the State Engineer making some additions to the project, and allowing for increased cost of labor and materials, the amount required was placed at $100,562,993. This project was accepted by the Legislature and enacted as Chapter 147, known as the $101,000,000 barge canal act.[3] This act provided for issuing 18-year canal improvement bonds not to exceed $101,000,000, a general annual tax of .0012 of a mill being authorized for each million of dollars in bonds outstanding in any fiscal year. The act directed improvement of the canals at a uniform bottom width of 75 feet, 12 feet depth, and 1,128 square feet of cross section, except at aqueducts and through cities, where the width and cross section might be modified under certain limitations. In rivers and lakes the channel was to have 200 feet bottom width, 12 feet depth and at least 2,400 square feet of cross section, locks to be 328 feet long, 28 feet wide and 11 feet over the sills. The route fixed by the act was by way of the Hudson River, Troy to Waterford, thence by a new channel to be constructed to the Mohawk above Cohoes Falls, to canalize the Mohawk River to Rome, thence down Wood Creek across Oneida Lake, down Oneida River and up Seneca River, rejoining the existing canal at Clyde, and thereafter by the old Erie Canal route to Tonawanda on the Niagara River, and by that river and Black Rock Harbor to Lake Erie. This act was submitted, as required by law, to the popular vote at the general election in November, 1903, the results showing 673,010 in favor and 427,698 against, or a majority of 245,312 for Barge Canal reconstruction.

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[3] *New York Assembly Documents 1903, No. 20.*

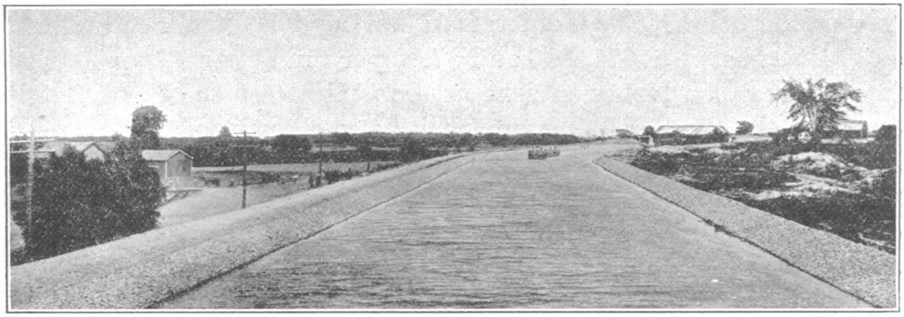

Fig. 5—A completed section of the Barge Canal near Rochester

Completion of surveys, plans and specifications took the entire year 1904. Bids were advertised and opened in December of that year, various contracts entered into and work began at Fort Miller, on the Champlain Canal, April 24, 1905, and at Waterford, on the Erie Canal, June 7, 1905. In that year the New York Legislature passed a law permitting an increase in size of the locks. After further study of this question, the state engineer recommended, and the board accepted plans for locks 328 feet long, 45 feet wide and 12 feet deep over sills; the material to be of concrete instead of cut stone as originally planned, and the gates to be of steel instead of wood.

Subsequently two important additions were made to the acts authorizing issuance of bonds for barge canal purposes. The State Senate, by resolution February 4, 1909, called on the State Engineer

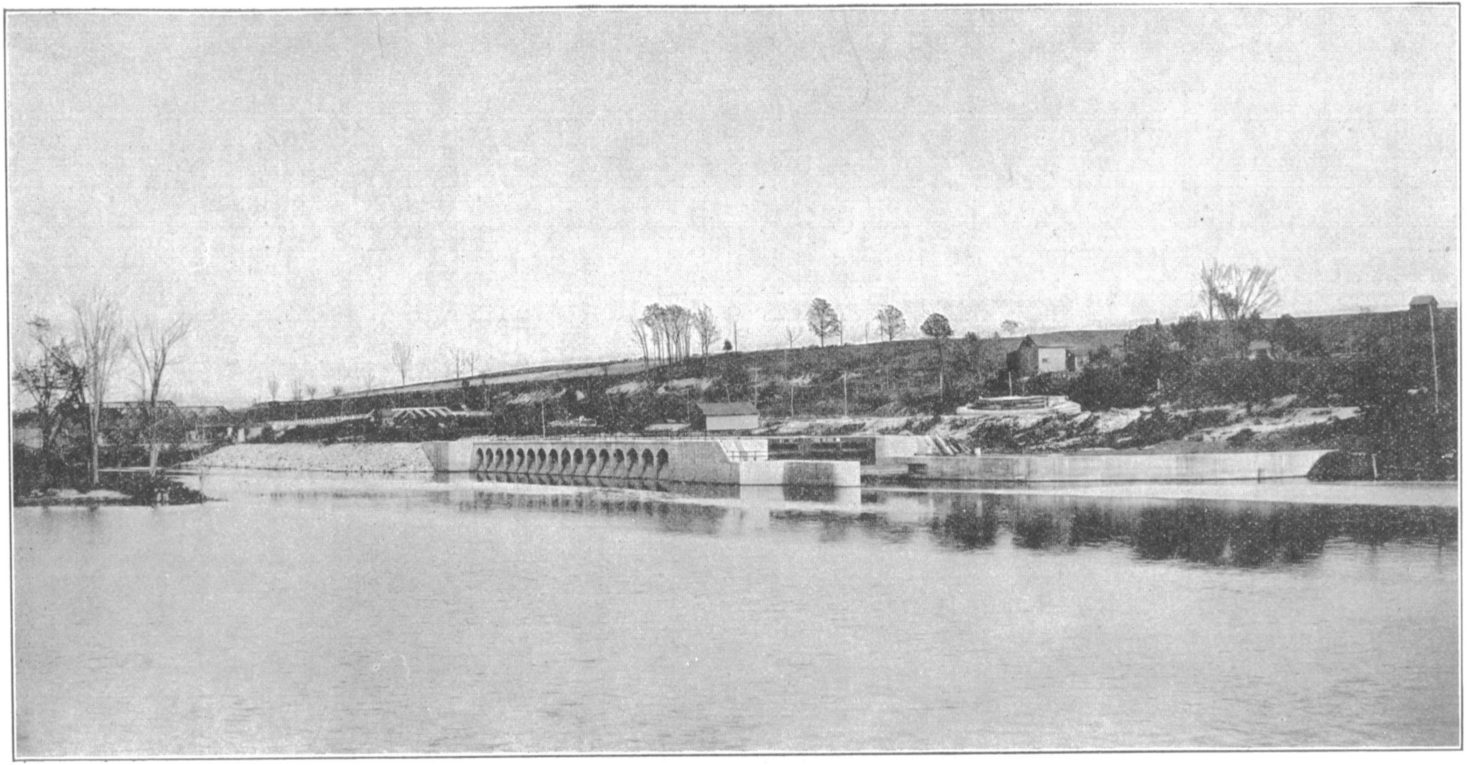

Fig. 6—"The Old and the New." Barge Canal lock in canalized river. Old barge in canal ditch above

for a report on the project of adding Cayuga and Senaca Lakes to the barge canal system. Mr. Frank M. Williams, then State Engineer, reported on March 27, that the project was entirely feasible, and that the cost of connecting both lakes would be a little over $8,000,000. Following this report, the Legislature adopted a bill authorizing the sale of $7,000,000 of bonds for enlarging the Cayuga and Seneca Canal to barge canal dimensions, so that after that date the so-called ''Finger Lakes'' project was incorporated in the general plan. Again in 1914, $19,000,000 was authorized to be issued, not for canal construction, but to cover a very important adjunct to facilitate the widest possible use of the canal; namely, construction of free public terminals at about fifty different cities and villages adjacent to the barge canal system.

Construction of the barge canal has proceeded continuously since work began in 1905, and according to the present estimates of the State Engineer's office, the eastern half of the waterway, including the Champlain branch between Troy and Whitehall; and the section between Troy, Oneida Lake and Oswego will be completed and opened to traffic during the present season of 1915. The western section between Rochester and Tonawanda is also completed to barge canal dimensions. In the central section, especially in the Clyde-Lyons region, and at Rochester, owing to many unforeseen difficulties, progress has been delayed, and work amounting to about 15% of the entire undertaking still remains to be placed under contract and will require two to three years under favorable conditions for completion. In the Clyde-Lyons region the trouble was due largely to the swampy and unfavorable nature of the soil, while at Rochester there were complications arising from necessary re-location of numerous railroad lines, requiring tedious litigation before a settlement could be reached. Serious delays were caused along the lower Mohawk, where abutting property owners and holders of riparian rights joined in litigation which long prevented the completion and closing of the concrete dams at Crescent and Vischers Ferry. Obstacles such as these, also larger expenses for land and railroad damages than were originally anticipated, and increased cost of labor and materials since inception of the work in 1905, have combined to raise the figures of total cost of construction so that one of the first acts of State Engineer Williams, on resuming possession of his office after re-election thereto in 1914, was to notify the Legislature that additional allowances would be required to complete the work already projected. A part of the delay was due also to the necessity of arriving at a definite understanding with the United States Government as to the share which the Federal engineers would take in improvement of approaches to the barge canal. Owing to the meagreness of Federal appropriations for New York projects for many years, the State Engineer's office assumed that it would be necessary for them to improve two sections strictly within the jurisdiction of the Federal Government: namely, the Hudson River between Troy and Waterford, and Black Rock Harbor, by which connection is had between Tonawanda and Buffalo. It was not until the State work had progressed for nearly five years that the Federal Government finally decided to assert its exclusive jurisdiction over navigable streams, and undertake the adequate improvement of the upper Hudson and the Niagara Rivers. Even now, although the Federal work is substantially completed at the western end, the projected improvements at Troy and on the descending channel between Troy and Hudson may lag behind the completion of the work undertaken by the State engineers.

(*To be continued*)